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Report of Transportation Test with Cantaloups and Honey Ball Melons from Imperial Valley, California to New York City June 27 to July 5, 1942 California Melon test 1942-1

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Introduction

This test constitutes part of an investigation of the effect of transit conditions on the carrying of fresh fruits and vegetables to distant markets which has been conducted for many years by the United States Department of Agriculture. Tests concluded in 1938 concerning market quality of cantaloups as influenced by maturity, handling and precooling practices are reported in Technical Bulletin No. 730. 1/

1/ Market quality and condition of California cantaloups as influenced by maturity, handling and precooling. U. S. Department of Agriculture Technical Bulletin 730, July, 1942, is obtainable from the Superintendent of Documents, Washington, D. C., price 15 cents.

Review of Previous Tests

Previous tests have shown that cantaloups, especially the Mildew Resistant #45 and selections from it should be picked full slip for highest quality and that vine ripe melons--fully mature but not soft--can be delivered to eastern markets in good condition if they are properly precooled and refrigerated.

The transit temperature of cantaloups is influenced more by the extent of precooling than by any other factor. As an example, the temperature of melons in the top layer, doorway stack averaged about 43°F. when they were precooled to 45°, and about 44° when precooled to 50°, 46° after precooling to 60°, and 48° when cooled to 70°, with the individual cars varying from 2° below the average to 4° above. These were loads consisting of 288 jumbo crates, 3 layers high, shipped under standard refrigeration with or without salt applied in transit.

The optimum transit temperature for the nine-day trip to New York differed for each maturity; "Fancy" melons of 1/2 to 3/4 slip that were hard and green required an average temperature enroute of about 50°; riper melons with 3/4 to full slip that were firm with little yellow color showing--called hardripe--needed temperatures in the range of 46° to 48°; whereas, choice melons being full slip and yellow but not soft needed 40° to 45°. Thorough precooling was necessary to obtain the low average transit temperature needed for melons of advanced maturity. When several maturities were shipped in the same car, best results were obtained by placing crates of advanced maturity in the bottom

layer of the load where it is normally cold and by placing less mature melons in the top layer where relatively warm temperatures prevail.

Handling methods, 1942

Since the completion of the previous tests in 1938, field handling and packing house methods have been changed somewhat. The present practice of handling cantaloups is similar to that formerly used only for Honey Dew melons. Cantaloup pickers now empty their sacks into trailers having hinged sideboards. At the packing shed the trailers are run on a track elevated on one side so that with the sideboard in an open position the melons roll into padded bins. From these bins the melons are rolled onto conveyor belts, past the graders, and into a second set of padded bins from which the packers select fruit for packing.

Cantaloups are usually precooled in the cars after loading is finished. Precooling is done with portable electric fans or with mechanical refrigeration. When portable electric units are used, they are set at the top bulkhead openings of the car. Cooling is accomplished by drawing the air of the car up through the ice in the bunker, forcing it out over the load, as illustrated on page 23, Technical Bulletin 730. In commercial practice the ice is salted to lower the temperature of the air blast. One hundred and twenty-five to two hundred and fifty pounds is generally used but 400 to 600 pounds is required to maintain an air blast of 40° or lower. When precooling equipment is operated efficiently, the melons can be cooled fairly well in 8 to 10 hours, but when fruit temperatures are high, a longer time may be required. After precooling is finished one of the car doors is opened and the fans are quickly removed.

When mechanical refrigeration is used, the loaded car is switched to a precooling siding where it is connected, by means of a canvas hood at the doorway, to a trackside unit equipped with blowers and cooling coils. The refrigerant (cold brine) used for precooling is generally piped from a nearby ice plant to the trackside unit. Cold air from the cooling unit is blown into the car through the upper part of the canvas hood and is returned to the cooler through the lower part. Canvas baffles are placed over the bracing and part way over the top crates in the car to force the air over the load and to the ends of the car before it returns through the load.

Purpose of 1942 tests

Shortage of refrigerator cars and motive power available for moving fresh fruit to market brought about by war conditions makes it desirable to use heavier loads of all produce and to eliminate all possible dead weight on trains if this can be done without jeopardizing the condition of the produce on arrival and during subsequent marketing.

In the test heavy loads of 37,596 pounds (480 jumbo crates) and 30,108 pounds (384 jumbo crates) were used along with the usual 22,308 pound load of 288 jumbo crates. Dead weight was reduced in some cars by using stage icing. With stage icing the ice grates are raised about three feet thereby reducing the ice capacity of the bunker about 45 per cent. If the ice held in the top half of the bunkers is sufficient to refrigerate the load from one icing station

to the next, then the ice held in the bottom half of the bunker is not necessary for adequate refrigeration and constitutes dead weight which can be eliminated by using stage icing. Also in the test, two cars were shipped under modified icing instructions to determine if it is necessary to reice cantaloups and honey-ball melons at all icing stations. Two other cars equipped with air circulating devices were used to determine the uniformity of temperature throughout this type of car when loaded more heavily than normal. All cars in the test were precooled by the shipper after loading and forwarded on the same train accompanied by observers.

Methods of Collecting Data

Commodity Temperature

When the cars were being loaded, distance-reading electric resistance thermometers were inserted in the center melon of crates indicated in Table 1. The thermometers were attached to a master cable provided with a thin door plate so that the cable could be brought out the doorway without interfering with the closing of the car doors. Temperatures were read from a point outside the car by plugging in a reading box equipped with selector switch at the end of the cable. Temperatures were read periodically during precooling and enroute. All thermometers were carefully checked against a standard thermometer at the Bureau of Plant Industry Laboratory at Beltsville, Maryland, and the proper corrections were applied to each reading.

Icing data

The ice used in the cars for the purpose of pre-icing, precooling, and refrigeration enroute was weighed at the time it was placed in the bunkers. Bunkers were filled in the usual way by using chunks of approximately 100 pounds in size for the bottom half of the bunker and chunks of about 50 pounds for the upper half. The chunks on top were chopped into fine pieces during the process of "barring down" the ice which is necessary to fill large air spaces between chunks.

Weather observations

General weather conditions during the time of harvest and enroute to market were observed and outside air temperatures and humidities were taken enroute by mercury and recording thermometers.

Test crates

Crates of melons comparable in size and maturity from one grower were shipped in the top layer and in other layers near the doorway of several of the cars in the test. Upon arrival at the market and again several days after unloading, inspections were made to see what effect the various methods of refrigeration and of loading had upon the melons.

Definition of terms

For a clear understanding of the test it seems desirable to define some of the terms used:

Pertaining to cars

Preiced: Bunkers of cars filled with ice by the railroad on the night before the car was delivered to the packing shed.

Dry Car: Car delivered to the packing shed without ice in the bunkers.

Pertaining to Precooling

Precooled with portable fans: Portable fans placed at top bulkhead openings to circulate air through the load and ice.

Precooled General American: Precooled with mechanical refrigeration from trackside units connected with a cold brine supply line.

Precooled "Preco": Precooled with permanent blowers installed under floor racks of cars as standard equipment to circulate the air up through the ice bunker and out over the load. These blowers are driven by belts from the axle of the car but for the purpose of precooling while the car is standing the axle belt is disengaged and an electric motor is used for power.

Pertaining to Loads

Three, four and five high loads: Loads of 288, 384, and 480 jumbo crates stowed six rows wide, sixteen stacks long, and 3, 4, or 5 layers high. 2/

2/ The jumbo crate has inside dimensions of 13 by 13 by 22-1/8 inches and is billed at 78 pounds, whereas the standard crate is 12 by 12 by 22-1/8 inches—68 pounds, and the pony crate is 11 by 11 by 22-1/8 inches billed at 57 pounds. Standard and pony crates require 336 and 378 crates respectively to make a 21,000 pound minimum load.

All crates were loaded on the side and car strips were nailed across the load on every layer. All cars were braced at the top doorway with 2 x 4's, leaving an air space about 18" wide between the A and B ends of the load.

A and B ends of car: B end is the end of car where the hand brake is located. A is the other end.

Pertaining to Refrigeration Enroute

Standard Refrigeration: The practice under which the bunkers are filled to capacity with ice at every regular icing station. These stations are located 24 hours or less apart enroute. Cost $105.00 Imperial Valley to New York City.

Standard Refrigeration, 2% or 3% salt 1 and 2: A shipping order providing addition of salt at the first icing station amounting in weight to 2 or 3 per cent of the ice capacity of the bunker and again at the second station amounting to 2 or 3 per cent of the weight of the ice used in re-icing the car. After the second icing station the bunkers are filled at all regular stations but no more salt is added. Cost, same as standard refrigeration plus cost of salt.

Rule 247: A shipping order by which the car may be delivered to the packing house either preiced or dry and reiced once or twice in transit. Cost including two reicings is $84.00 from Imperial Valley to New York City. A variation of Rule 247 used by citrus shippers but not shown in the cantaloup tariff allows the shipper to initially ice the car. One of the test cars was initially iced by the shipper at an estimated saving of fifty cents per ton of ice used.

Rule 254: A shipping order calling for a car preiced by carrier, replenished by carrier after loading, and reiced up to twice enroute at the option of the shipper. Cost including two reicings enroute, $92.00 from Imperial Valley to New York City.

Full Bunker: Entire space in ice bunkers used for ice. Bunker capacity of cars used, 11,500 pounds total.

Stage icing: Only upper half of ice bunker used. Lower half partitioned off by raising the ice grates about three feet. Bunker capacity of stage ice cars used, about 6,000 pounds total.

Pertaining to temperature data:

Average transit temperature: The average temperature of melons at all thermometer positions from start of precooling until arrival at Jersey City yards, covering a period of about 8 1/2 days in this test.

Pertaining to melons

Fancy: A maturity grade; melons picked 3/4 to full slip, hard, and green in color.

Hard Ripe: A maturity grade; melons picked full slip, hard, with some yellow showing between netting.

Choice: A maturity grade; full slip melons, yellowish and firm but not soft.

Results and Discussion

In the following discussion of the test, general results will be considered first followed by a detailed discussion of the transit temperatures, ice used, and precooling data.

Loading and Shipping Data

Tables 2, 3 and 4 present an outline of the test including the size of the various loads and methods of refrigeration, the shipping points and shippers, and other records obtained during the loading of the test cars. The melons were picked and packed during the morning of the loading day (June 27) for all cars except cars B and G which were packed and loaded in the afternoon. Cars A, B, G, and H were precooled at the packing house, and precooling was started soon after loading. Cars C, D, E, and F had to be switched to a

siding before precooling could be started. Most of the cars were precooled until midnight and shortly thereafter they were switched to the ice dock for reicing.

Weather encountered:

Table 5 is a record of the weather encountered and itinerary of the trip. The night before loading was unusually cool and windy. On the day of loading and the two days enroute to El Paso, maximum temperatures of 105° and 114°F. were recorded. From El Paso to Kansas City it was cloudy with maximum temperatures of 85° to 90° and east of Kansas City moderate temperatures with clouds and occasional rain were encountered. The mean outside air temperature from noon June 27 to noon July 5 was 76.3°F. 3/

3/ Mean temperatures during the earlier tests previously referred to were 85.4°F. for June 20-28, 1936, and 78.9°F. June 12-20, 1937.

Melon temperatures enroute

With transportation tests under refrigeration, it is customary to compare average temperatures of the top, middle and bottom layers of the load. The difference in temperature of various portions of loads in refrigerator cars is usually greater between layers than between stacks or vertical planes across the car. Middle layer temperatures in this test were confined to the quarterlength position which has been found to represent very closely the average temperature of the layer. Usually, in a car under refrigeration, the top layer is the warmest in transit and the bottom layer is coldest. However, owing to height of load and fan equipment used, the middle layer in car H, (5 high load with Presco fans) was the warmest in that car.

Average temperatures

Graphs representing the average temperature enroute of the top, middle and bottom layers of the test cars are shown in figures 1, 2, 3 and 4. A summary of the amount of cooling that occurred in each car, the average temperature of the warmest layer and the ice and salt used to refrigerate the load are shown in table 6. Average temperatures of the loads at daily intervals are shown in table 7. The cars in this test showed a wide variation in temperature attained during precooling and during the first three days enroute. Car averages after precooling ranged from 45° (car D) to 67° (car G). The time elapsed before top layers reached 50° ranged from 8 hours in cars C, D, E and F to 46 and 48 hours in cars G and B respectively. As the trip to the market progressed, temperature differences between cars became increasingly less with the result that average transit temperature of the warmest layers of the warmest car (Car B, table 6) was only about 5° higher than the average of the warmest layer of the coldest car (Car H.). The application of 2% salt at the first and second icing stations to cars A and B and of 3% salt to cars G and H undoubtedly aided materially in lowering the temperature of these cars which were not precooled to as low a point as cars C, D, E and F. At the market cars A, B, G and H were unloaded on the night of arrival, cars D and E were held one day on track before unloading, car F was held

two days, and car C was held four days before unloading. Only one car (car C) was reiced during the holding period at the market. Load temperatures did not rise more than 2° during the time any of these cars were held over.

Condition of melons when unloaded

The condition of melons when unloaded at New York is shown in table 8. Cars A and B containing fancy Honey Balls were loaded 3 and 4 layers high respectively. Car B was very slow in cooling, requiring about 48 hours for the top layer to cool to 50° (Figure 1), and upon unloading on the eighth night was slightly too ripe for best market demand, whereas (Car A), the 3 high load which cooled to 50° in about 12 hours arrived in better condition (Table 8). Cars C and D containing fancy and hard ripe Honey Balls were both loaded 4 layers high but they cooled faster and had lower transit temperatures than cars A and B, (Figure 2). Car C was held four days on track at New York and Car D was held one day making 9 and 12 days before unloading. Hard ripe melons were in good condition on the ninth day (Car D) but were slightly overripe on the twelfth day (Car C). Fancy melons in both cars were definitely green even after four days on track, showing that low transit temperature is not desireable for hard green melons. Cars E and F contained cantaloups and were well cooled with temperatures between 45 and 50° at the end of precooling, (Figure 3). Fancy melons in both cars arrived too green for best market demand even after holding two days on track, whereas hard ripe melons in these cars arrived in good condition. Cars G and H were heavy loads of fancy cantaloups. The cooling of both cars was slow, taking 38 to 46 hours for the middle layers to reach 50° , (Figure 4). With this slow cooling, considerable ripening occurred enroute but since the load was made up of fancy melons the ripening in transit put them in good marketing condition.

With Hard Ripe melons, more ripening occurred in transit in cars that were not precooled to 50° than in those precooled to 50° and below. Likewise Fancy melons precooled to 50° and lower arrived too green for best market demand.

Crates of Hard Ripe cantaloups from the same field were shipped in the doorway of cars A, E, G and H. Cars A, G and H were unloaded July 5th and the test crates were held in a 45° room until the following night when car E was unloaded. There was not much difference in the average temperature of the top layers of these cars (table 6); consequently, most of the test melons ripened very little in transit. However, crate 8 in the middle layer of the 5-high load (car H) cooled slowly, requiring about 40 hours to reach 50° , and arrived slightly riper than the other crates which cooled faster.

The test crates were held at retail store temperature for five days at the end of which time about 75 per cent of the melons in the crate from the middle layer of the 5-high load (crate 8) were soft, whereas in crates from the other cars only 60 per cent were soft.

During the holding period at the market, decay and surface mold developed in all test crates. Decay consisted of small, soft spots on about half the melons. Wrapped melons remained wet for a long time after removal from the car and surface mold (Cladosporium sp.) developed on the rind. On melons that were not wrapped, the sweating that occurred upon removal from the cold car soon dried and surface mold did not develop.

Comparison of 3-and 4-high loads

The effect of loading cantaloupes 4 layers high on transit temperatures is brought out by a study of temperatures in cars A and C. Car A was loaded 3 high, precooled to 54° and was shipped under standard refrigeration with salt applied at Calexico and Yuma. Car C, loaded 4 layers high, was precooled to 49° and was shipped under standard refrigeration, without salt. At Yuma and Tucson, both cars were nearly alike in average temperature (table 7), but from El Paso east the 4-high load was nearly 3° warmer than the 3-high load. The salting of the 3-high load accelerated cooling during the first two days but after leaving El Paso, the cooling value of the salt was gone and the subsequent lower temperatures in this car can be attributed to the lower 3-high load.

Comparison of 4-high loads with and without forced air circulation

Car B, a standard car, and car G equipped with Preco fans for air circulation enroute were loaded 4 layers high and were shipped under standard refrigeration plus salt at the first two icing stations. Both cars were rather poorly precooled having final average temperatures of 66° and 67° respectively. When they reached Tucson early the second day, the average temperature in the standard car was 48° compared with 50° in the fan car, but the next day at El Paso they were both about 44°F.

Car G, with forced air circulation, arrived at New York with an average temperature of 37°, which was about 3 1/2° colder than car B without forced circulation. The range in temperature between the top and bottom layers ofcar B was 14° on the second day and 3° on arrival, but in car G it was not over 3° at any time. Average temperatures of the top layers enroute were 48° and 46° respectively.

Average temperature of the warmest layer of the 4-high load under forced air circulation (car G) was nearly the same as the warmest layer of the 3-high load without forced circulation. (Car A).

Five-high load under forced air circulation

Car H was loaded 5 layers high in a car equipped with Preco fans for air circulation enroute. It was shipped under standard refrigeration plus 3 per cent salt at the first two icing stations. No direct comparison can be made with its' companion, fan car G, loaded 4 high, because both were not precooled to the same temperature. Car H, starting with an average temperature of 59° after precooling, was 44° at El Paso on the third day, 39° at Kansas City on the fifth day and 36° on arrival at New York. Although the average temperature was slightly lower than that of car G (4-high Preco), softening developed especially in the middle layers. The ripening that occurred with fancy melons in the 5-high load indicates that heavy loads of riper melons would not carry without forced air circulation and that choice melons probably would not carry even with forced air circulation.

Comparison of full bunker and stage icing

Cars C and D were loaded 4 layers high, precooled to 48.5° and 45° respectively and were shipped under standard refrigeration. In car C the ice bunkers

were used to full capacity (10,517 lbs.). In car D, under stage icing, the capacity of the upper part of the bunker used was 5,961 pounds. In figure 2 the lines representing the average temperature of the first, third and fourth layers of both cars run practically parallel for the entire trip after precooling, thus showing no difference in refrigeration of the load shipped under stage icing compared with the load under full bunker icing. Stage icing reduced the dead weight of ice hauled in this car by 4,556 pounds without loss of refrigeration.

Cars shipped under modified icing instructions

Car E was loaded dry, without ice in the bunkers and was initially iced with 10,980 pounds of ice after precooling. It was reiced at Dalhart, Texas, on the fourth day enroute and at Clearing, Illinois, on the sixth day. Car F was initially iced with 6,253 pounds of ice in the upper half of the bunker, replenished after precooling, and was reiced at Dalhart and Clearing. Both loads were 3-high (288 crates--22,464 lbs.). Precooling was similar; temperatures at the end being 51° in car E, and 47° in car F. During the first three days enroute on the trip from El Centro to El Paso both cars were nearly alike in temperature. (figure 3)

At El Paso car F was purposely not reiced in order to observe the effect of a further reduction of the ice in the bunkers on the rate of cooling of the melons. Both cars, E and F, were reiced the next day at Dalhart. The delay of one day in the reicing of car F resulted in somewhat less cooling of the fruit under stage icing in car F, than occurred under full-bunker icing in car E. This is shown by comparing the temperature curves on June 30 and July1, while the cars were enroute from El Paso to Dalhart.

Equal cooling of the melons for the first three days occurred under both methods of refrigeration while there was a considerable supply of ice in the stage-iced car but slightly slower cooling was evident after leaving El Paso when the ice supply became depleted. Practically the same rate of cooling of the melons occurred after the cars were reiced at Dalhart. Under standard refrigeration in which the bunkers were filled at least once every twenty-four hours, stage icing was as effective as full bunkers at all times.

The results shown by cars E and F, figure 3, are in agreement with those obtained in other tests with stage icing. Shipments forwarded under this refrigeration service during warm weather usually require reicing in transit about one day sooner than comparable shipments under full-bunker icing.

General discussion of load temperatures

Car C (4-high, standard refrigeration, full bunker), car D (4-high, standard refrigeration, stage icing), car E (3 high, rule 247), and car F (3-high, rule 254, stage icing), all precooled to between 45° and 50° and shipped without salt, maintained load temperatures between 40° and 45° in transit whereas car A (3-high, standard refrigeration, 2% salt 1 and 2) precooled to only 54° but salted at the first two icing stations maintained an equally low temperature in transit. Temperatures of these cars were adequate for carrying hard ripe melons to eastern markets. However, choice melons would require loading in the colder layers at the bottom. Full cars

of choice melons would undoubtedly require longer precooling and lower transit temperatures of than those obtained in this test. Fancy melons arrived too green in cars that were precooled to 50° or lower and they ripened too much in cars where precooling did not go below 65°F.

Comparison of ice used in test cars

Icing records show meltage of 9,516 to 27,039 pounds during loading, precooling and shipping of the test cars (table 6). The most meltage occurred in cars containing heavy loads of warm melons which were precooled with ice. In cars A, B, G and H where ice was used for precooling, the meltage during loading and precooling amounted to between 5,000 and 9,000 pounds resulting in a 19° to 24° reduction in the temperature of the load. Records of cars C, D and F in which bunker ice was not used for precooling indicate that nearly a ton of ice melts during switching and loading prior to precooling. This meltage was avoided in car E by delaying initial icing until after the car was precooled and the subsequent temperature in transit was not materially affected by this procedure.

Meltage of ice in transit was affected by the precooling temperature. Cars C, D, E and F precooled to between 45° and 50° , used 10,000 to 12,000 pounds of ice enroute to New York. Standard cars A and B which were precooled to 54° and 65° respectively used 11,000 and 13,000 pounds whereas fan cars G and H precooled about the same as cars A and B used about 18,000 pounds each enroute. Comparing cars B and G which were both warm, 4-high loads, fan car G used about two tons more ice enroute than standard car B and the load temperature was 5° lower as shown by the total drop in temperature between time of loading and unloading. In this instance forced air curculation in fan cars increased ice meltage enroute by about 25 per cent and increased the cooling of the load by about 13 per cent.

In cars handled the same way, the amount of ice used for precooling and that needed enroute was somewhat less this year than the amount melted in the tests of 1936 and 1937. It is probable that the difference in ice meltage in the two tests was due in large part to differences in the loading temperature of the melons. In the 1936 test the melons were picked in the afternoon and averaged 86.7° whereas in this year's test the melons in car A were picked in the morning and averaged only 78° . The cool night preceding loading and cool weather during part of the trip this year resulted in relatively low melon temperatures when loaded and in less heat leakage from outside the cars.

Data obtained during precooling of test cars

A summary of data obtained during the precooling of the test cars is shown in table 10. In calculating the heat removed from the load, field heat and heat generated by the fruit are shown in separate columns. Calculations for field or sensible heat were based on 75 pounds of melons per crate with a specific heat of .92 and 5 pounds of wood per crate, specific heat .327, for the total drop in average temperature of the load during precooling. Calculation of vital heat generated was based on the mean average temperature of the load during precooling. Heat of respiration of the melons was interpolated from the data presented in Technical Bulletin 730:- 26,400 B.t.u. 4/ per ton per day at 90°F., 24,200 B.t.u. per ton per day at 74°F., 4,400 B.t.u. per ton per day at 50°F., and 2,200 B.t.u. per ton per day at 32°F.

4/ British thermal unit or heat extracted to cool one pound of water 1°F. (from 64°F. to 63°F.) 288,000 B.t.u. is equivalent to amount of heat absorbed by melting of one ton of 32°F. ice.

Total heat removed from the load is the sum of the sensible and vital heat. Heat penetrating the walls of the car from outside and the heat generated by precooling fan motors are not included in the table. The column showing the ice melted represents the meltage between the final initial icing ("retouch" by railroad) and replenishing after precooling--a period of about 24 hours.

During the day the test cars were loaded, the temperature of the melons as they were hauled in from the field ranged from 60° at 8:00 a.m. to between 80° and 90° from 2:00 p.m. to 7:00 p.m. Minimum and maximum air temperatures for the day were 58° and 105°. The wide difference in temperature of melons from the field was reflected in the temperature of the load when loading was finished. At the start of precooling car D, a morning load, was 23° colder than car B, an afternoon load, (table 4). (Car D could be precooled to 45° in ten hours because it had a low starting temperature and under the same conditions it would have taken 8 to 10 additional hours and 2.6 tons more ice to cool car B to 45° because of the added heat attending mid-day and afternoon picking.)

The test cars fell into three groups with respect to final precooling temperatures. With a precooling period of only 8 to 10 hours and a cooling rate of 2 to 3° per hour, the final temperature depends largely on the starting temperature. It was possible to cool cars D and F to about 45°F. in this time because the melons were cool when loaded, (table 10). Cars A, C, E and H had temperatures of 70° to 75° before precooling and were cooled to temperatures of 50° to 59°. Cars B and G starting with 87° and 83° melons, which is not unusual in Imperial Valley, finished with temperatures of 65° and 67° respectively after 8 or 9 hours precooling. Longer precooling and the use of more salt to maintain cold air blasts would have been necessary to precool the warm cars to 50° or lower. Results of other tests not herein reported, indicate that a total of 500 to 700 pounds of salt and replenishing the bunkers with ice would be required during precooling to maintain the air blast at 40° or lower and to obtain cooling rates of 3° to 4° an hour.

Since the test loads varied so much in weight and temperature, a comparison of the precooling accomplished is shown in table 10 as B.t.u. absorbed per 1,000 pounds of ice melted. One thousand pounds of 32° ice absorbs 144,000 B.t.u. upon melting. In cars A and B, from 55 to 65 per cent of the cooling effect of ice melted went toward reducing the temperature of the load and therefore 35 to 45 percent was lost to the outside air through the walls and through open doors during loading. In the fan cars, G and H, about 40 per cent went toward cooling the load and 60 per cent was lost. The amount of this refrigeration lost through the open doors during loading and the amount that leaked out under pressure during precooling were not determined.

Temperature of exposed melons

While cars D and E were being precooled, extra thermometers were placed in outer melons in crates in the top layer and at the doorway where the precooler could reach them conveniently.

In table 11 it will be seen that at 7:30 p.m., after 6 1/2 hours cooling, the outer melons in the top layer of car E averaged 41° whereas the center melons of the same crates averaged 51° and the average of 9 points throughout the car was 53°. After 10 hours precooling, average temperatures at these respective places were 40° , 48° and 50°. Similar differences in which outer melons in the top layer were 8° to 10° colder than the average of the car were found in car D, a 4-high load. In car E the center melon of the bottom doorway crate was only slightly warmer and the outer melon was only slightly colder than the average of the car after the first few hours of cooling, so this crate supplied a good indication of the temperature of the load. However, in car D, loaded 4 layers high, part of the cold air blast struck the load underneath the canvas baffle at the doorway because the connecting hoods were not designed for high loads and as a result all the doorway crates cooled nearly as fast as those in the top layer lying directly in the air blast.

SUMMARY

A transportation test was made with eight cars of melons including cantaloups and honey-ball melons in which temperatures were taken with distance reading electric resistance thermometers. The test was made from Imperial Valley, California to New York City, June 27, 1942 to July 5, 1942. Comparisons were made of loads 3, 4, and 5 layers high; of full bunker icing and stage icing; of standard refrigeration and modified icing; and of standard cars and cars equipped with Preco fans for forced air circulation in transit.

With a 5-high load in a fan car, Fancy melons ripened somewhat but carried satisfactorily, whereas Hard-ripe melons softened enroute especially in the middle layers where cooling was slow. Choice melons loaded 5 high probably would arrive overripe under normal train schedules, and any delay in transit would increase the trouble particularly in standard cars.

Loads four layers high, 30,000 lbs., shipped in standard cars and well-precooled, carried satisfactorily although not quite as well as regular 3-high loads of 22,000 lbs. These results have special significance under existing war conditions due to the requirement for loading all refrigerator cars to full capacity.

Stage icing, using only the top half of the bunker for ice, was as effective under standard refrigeration as full bunker icing and was approximately as good when modified icing was used. Stage icing eliminated about 5,000 pounds of dead weight per car by reducing the amount of ice carried.

Cars shipped under modified icing, rules 247 and 254 and reiced twice, at Dalhart, Texas and Clearing, Illinois, carried about as well as those shipped under standard refrigeration. Thorough precooling to 50° or colder is essential for cars shipped under these rules.

In five of the eight cars of the test, the top or warmest layers of the various loads cooled to 50° in 12 hours or less whereas in the other three cars it took 36 to 48 hours to reach this point. Slow cooling resulted in ripening enroute and, although this is desirable for Fancy melons, fast cooling was necessary to keep better quality Hard-ripe melons from arriving overripe.

During loading and precooling, cars loaded in the afternoon were as much as 23° warmer than morning loads and required as much as 2 1/2 tons more ice to precool. When precooling progressed at a rate of 2° to 3° per hour and the time was limited to about 10 hours, the starting temperature had a big effect on the final precooling temperature.

Salting at the first two icing stations was effective in producing low transit temperature in cars that could not be precooled below about 55° before train time.

Heat entering cars during loading may be responsible for 35 to 60 per cent of the ice meltage occurring during loading and precooling.

During precooling, melons in top layer crates, which are conveniently located for taking fruit temperatures with hand thermometers, were 8° to 10° colder than the average of the load but doorway crates located in the return air stream were fairly close to the average temperature of the car so long as the baffles were tight enough to keep the air blast from passing at the doorway.

Personnel of test trip

W. R. Barger, Associate Physiologst.	Bureau of Plant Industry Fresno, California.	Brawley, California to New York City.
Glenn L. Embree, Scientific Aid.	Bureau of Plant Industry Pomona, California.	Brawley, California to New York City.
Harold D. Johnson Assoc. Transportation Specialist.	Transportation Division of Agricultural Marketing Administration, Washington D. C.	Brawley, California to New York City.
C. J. Hayes, General Clerk.	Pacific Fruit Express Co., San Francisco, California	Brawley, California to New York City.
J. N. Brundage	Erie Railroad.	Clearing, Illinois to New York City.

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TABLE I

Location of Thermometers in Test Cars (head end)

Calif. Melon 1942-1

No. of Bulb	Melon or air	Layer	Row	Stack
			3-high load	
1	Air	Bot. bulkhead	Centerline	--
2	Melon	1	"	1
3	"	3	"	1
4	Air	Top bulkhead	"	--
5	Melon	2	So. Wall	4
6	"	1	Centerline	4
7	"	2	No. Wall	4
8	"	2	Centerline	4
9	"	3	"	4
10	"	3	"	8
11	"	1	"	8
12	Air	Top doorway	"	--
			4-high load	
1	Air	Bottom bulkhead	Centerline	--
2	Melon	1	"	1
3	"	4	"	1
4	Air	Top bulkhead	"	--
5	Melon	3	So. Wall	4
6	"	1	Centerline	4
7	"	3	No. Wall	4
8	"	3	Centerline	4
9	"	4	"	4
10	"	4	"	8
11	"	1	"	8
12	Air	Top doorway	"	--
			5-high load	
1	Air	Bot. bulkhead	Centerline	--
2	Melon	1	"	1
3	"	5	"	1
4	Air	Top bulkhead	"	--
5	Melon	3	So. Wall	4
6	"	1	Centerline	4
7	"	3	No. Wall	4
8	"	3	Centerline	4
9	"	5	"	4
10	"	5	"	8
11	"	1	"	8
12	Air	Top doorway	"	--

TABLE 2

Outline of Test
Calif. Melon 1942-1

Car	Car No.	Load	Method of Refrigeration
	PFE	Layers	
A	74913	3-high	Preiced: precooled 6-3/4 hrs. with portable fans; (Repl. by shipper during precooling); Std. refrigeration; Full bunkers. Salt: 125 lbs. added during precooling; 230 lbs. at 1st reicing; 23 lbs. at 2nd reicing.
B	74746	4-high	ditto except precooled 8-3/4 hrs. Salt: 250 lbs. added during precooling; 230 lbs. at 1st reicing; 37 lbs. at 2nd reicing.
C	74604	4-high	Preiced: precooled 8-1/2 hours (General American) Standard refrigeration. Full bunkers.
D	74765	4-high	Preiced: precooled 10 hours (General American) Standard refrigeration. Stage icing.
E	74499	3-high	Dry car; initially iced by shipper; precooled 10 hours (General American); Rep..; reiced at Dalhart, Texas and Clearing, Ill. Full bunkers.
F	74712	3-high	Preiced: precooled 10 hours (General American) Replenished; reiced at Dalhart, Texas and Clearing, Illinois. Full bunkers.
G	76295	4-high	Preiced; precooled 8 hours (Preco); Replenished by shipper during precooling; Standard refrigeration; Full bunkers; Preco fans. Salt: 300 lbs. added during precooling; 345 lbs. at 1st reicing; 43 lbs. at 2nd reicing.
H	78165	5-high	Preiced: precooled 9-1/4 hours (Preco); Replenished by shipper during precooling; Standard refrigeration: Full bunkers. Preco fans. Salt: 400 lbs. added during precooling; 345 lbs. at 1st reicing: 40 lbs. at 2nd reicing.

TABLE 3

Shipping Points and Shippers.

Calif. Melon 1942-1

Car	Car No.	Load	Shipping Points	Shippers
	PFE			
A	74919	3-high	Calexico, Calif.	Farley Fruit Co.
B	74746	4-high	Calexico, Calif.	Farley Fruit Co.
C	74604	4-high	Brawley, Calif.	American Fruit Growers, Inc.
D	74765	4-high	Brawley, Calif.	American Fruit Growers, Inc.
E	74499	3-high	Brawley, Calif.	Wester Fruit Growers.
F	74712	3-high	Brawley, Calif.	Wester Fruit Growers.
G	76295	4-high	El Centro, Calif.	V. H. Azhderian
H	76165	5-high	El Centro, Calif.	V. H. Azhderian

TABLE 4

RECORD OF LOADING TEST CARS

ORIGIN Imperial Valley, Calif. COMMODITY Cantaloups & Honey Ball

DESTINATION New York City VARIETY MR #45 Cant. Selections

TEST NO. California Melon 1942-1

CAR NO. and INITIAL	LOADING									TEMPERATURES			OBSERVER
	START		FINISH		METHOD			PACKAGES		OUTSIDE		Av.	
	Date 1942	Time	Date	Time	Rows	St'ks	Lay'rs	No.	Brand	Max.	Min.	Fruit	
PFE	June									°F.	°F.	°F.	
A 74919	27	10:15A		11:15A	6	16	3	288	Honey ball	90	88	78	G.L.Rygg
B 74746	27	1:50P		2:50P	6	16	4	384	Honey ball	100	95	87	G.L.Rygg
C 74604	27	11:10A		1:40P	6	16	4	384	Honey ball	96	85	78	G.L.Embree
D 74765	27	8:00A		11:00A	6	16	4	384	Honey ball	85	75	62	G.L.Embree
E 74499	27	9:00A		12:15P	6	16	3	288	Cantaloups	95	85	72	H.D.Johnson and W.R.Barger
F 74712	27	9:00A		12:15P	6	16	3	288	Cantaloups	95	85	67	H.D.Johnson and W.R.Barger
G 76295	27	2:00P		3:45P	6	16	4	384	Cantaloups	97	97	90	E. M. Harvey
H 76163	27	9:30A		2:30P	6	16	5	480	Cantaloups	97	85	78	E. M. Harvey

TABLE 5 - Sheet 1
Itinerary.
Outside Temperature and Weather
en route.
Calif. Melon 1942-1

Place	Date 1942	Time Arrive	Time Depart	Temp. °F.	Weather Conditions
	June				
Brawley, Calif.	28	---	4:25 A	70	Clear
El Centro		5:40 A	6:00 A	67-68	"
Calexico		6:25 A	7:30 A	73-90	"
Cocopah, Mexico		8:30 A	---	90	"(Customs)
Cantu, Mexico		10:00 A	---	94	"
Colorado River		11:00 A	11:45 A	94	"
Yuma, Arizona		1:05 P	2:40 P	100-105	"
Weldon		5:00 MT	---	109	"
Mohawk		6:30	---	114	"
Gila Bend		8:30 P	10:40 P	100-87	"
En route	29	4:30 A	---	60	Cloudy
Tucson		6:30 A	11:30 A	65	"
Summit		1:00 P	---	104	Clear
Chamiso		2:00 P	---	105	"
Dragoon		3:30 P	---	104	"
En route		4:00 P	---	112	"
Bowie		5:45 P	---	105	Part cloudy
San Simon		7:00 P	---	100	" "
Steins, N.M.		8:00 P	---	97	" "
Lordsburg		8:30 P	9:00 P	90-85	" "
En route	30	12:30 A	---	80	" "
		3:30 A	---	73	" "
El Paso, Texas		4:30 A-	10:10 A	73-85	Clear
En route, N.M.		11:00 A	---	91	"
Oro Grande		12:00 M	---	91	"
Almogordo		1:25 P	1:45 P	88-84	Rain
Tularosa		3:00 P	---	81	"
En route		4:00 P	---	90	Cloudy
Carrizozo		4:30 P	6:15 P	80-71	Cloudy & rain
En route		7:00 P	---	62	Rain
		9:00 P	---	55	"
Vaughn		10:30 P	11:00 P	52	Cloudy
En route	July 1	3:45 A	---	58	"
Tucumcari		4:00 A MT	6:00 A CT	58-59	Part Cloudy
Logan		7:00 A	---	61	" "
Naravista		8:00 A	---	65	Cloudy
Middlewater, Texas		9:00 A	---	67	"
Dalhart		9:25 A	12:00 M	66-70	Part cloudy
Brickel		12:55 P	2:00 P	68-68	" "
Hooker, Okla.		4:00 P	---	80	Clear
Liberal Kan.		4:30 P	5:00 P	88-88	"
Mineola		7:00 P	---	82	"
Greensburg		8:00 P	---	69	"
Pratt		8:45 P	9:53 P	67-64	"
Harrington	2	3:00 A	---	--	--
Topeka		5:45 A	---	65	Cloudy

Place	Date	Time		Temp °F.	Weather Conditions
		Arrive	Depart		
	July				
Lawrence Kans	2	6:35 A	---	65	Cloudy
Kansas City, Kans.		8:15 A	2:45 P	68-84	Raining
Excellsior Spring, Mo.		4:10 P	---	86	Cloudy
Trenton		6:00 P	6:23 P	84	Clear
Princeton	P	8:00 P	---	76	"
Lineville, Iowa		8:40 P	---	72	"
Eldon		10:40	---	71	"
Rock Island, Ill.	3	4:00 A	---	70	Raining
Silvis		5:00 A	7:20 A	62-64	"
Seneca		11:00 A	---	70	Partly cloudy
Joliet		12:00 M	12:15 P	74	" "
Blue Island		1:15 P	1:30 P	76	" "
Clearing		2:15 P	6:00 P	78-65	" "
Hammond, Ind.		8:00 P	9:05 P	65	" "
Huntington	4	2:15 A	---	62	" "
Marion, Ohio		6:30 A CT	9:40 A ET	66-77	Raining
Barbarton		12:20 P	---	78	Cloudy
Kent		12:55	1:25 P	80-80	"
Meadville, Pa.		4:25 P	4:50 P	80	"
Jamestown, N. Y.		7:00 P	---	70	"
Salamanca		8:45 P	8:55 P	65	"
Hornell	5	12:30 A	6:05 A	58-55	Fog
Owego		8:30 A	---	66	Cloudy
Susquehanna, Pa.		10:15 A	11:48 A	77-80	"
Port Jervis, N. Y.		3:30 P	3:45 P	89	Scattered clouds
Jersey City, N. J.		7:00 P	---	83	---
New York, New York	6	---	---	60-85	Rain

Table 6

Summary of temperature and icing and salting records of test cars of cantaloups from Imperial Valley, Calif., to New York City, 6/27 to 7/5/42.

Car	Load, layers high	Refrigeration	Melon temp. when loaded	Melon temp. after pre-cooling.	Temp. drop before shipping	Melon temp. on arrival	Temp. drop in transit	Total temp. drop	Av. in-transit temp. top layer	Time for top layer to reach 50°	Ice Melted During load- and precool- ing	Ice Melted In transit period	Ice Melted Total	Total salt supplied.
			°F	°F	°F	°F	°F	°F	°F	hrs.	lbs.	lbs.	lbs.	lbs.
A	3	Std. 2% salt 1/	78	54.1	23.9	39.8	14.3	38.2	45.5	12	5,088	11,169	16,257	378
B	4	"	87	65.6	21.4	40.4	25.2	46.6	47.9	48	7,592	13,320	20,912	517
C	4	Std.	78	48.5	29.5	41.2	7.3	36.8	46.6	8	1,932 6/	11,899	13,831	0
D	4	Std. stg.62		45.0	17.0	39.4	5.6	22.6	42.3	8	1,976 6/	10,261	12,237	0
E	3	Rl. 247-B72 2/		50.4	21.6	38.5	11.9	33.5	44.6	8	0 6/	9,516	9,516	0
F	3	Rl. 254-B67 3/		46.7	20.3	40.5	6.2	26.5	44.9	8	1,850 6/	11,214	13,064	0
G	4	Std. 3% salt 1/ 4/	90	67.3	22.7	37.0	30.3	53.0	45.8	46	8,735	17,235	25,970	688
H	5	"	78	58.9	19.1	36.6	22.3	41.4	42.4	30	8,558	18,481	27,039	785
H 5/	5	"							43.7	38				

1/ Salt added to ice during precooling and at the 1st and 2nd icing stations (Imperial Valley & Yuma) enroute.
2/ Upper half of bunker only used for ice.
3/ Car initially iced after precooling. Reiced Dalhart, Texas and Clearing, Illinois.
4/ Preiced car replenished at Brawley, Calif., after precooling, reiced Dalhart, Texas and Clearing, Illinois, upper half bunker only used for ice.
5/ Middle layer of crates. In all other cars top layer was warmest.
6/ Ice meltage during precooling by mechanical refrigeration.

TABLE 7

Temperatures of melons enroute (average of 9 positions in each car)

CAR			A	B	C	D	E	F	G	H
P.F.E.			74919	74746	74604	74765	74499	74712	76295	76163
Height Load (layers)			3	4	4	4	3	3	4	5
Variety			Honey Ball		Honey Ball		Cantaloup		Cantaloup	
Refrigeration	Date	Time	Std. 2%	salt 1 & 2.	Std.	Std. stage	Dry car.	stage.	Std. 3%	salt 1&2
			AVERAGE TEMPERATURE OF MELONS							
When loaded	6/27	---	78 °F	87 °F	78 °F	62 °F	72 °F	67 °F	90 °F	78 °F
Start of precool.	6/27	---	71.9	87.1	74.7	64.0	71.2	68.0	83.1	70.1
End of precool.	6/27	---	54.1	65.6	48.5	45.0	50.4	46.7	67.3	58.9
Yuma, Arizona	6/28	noon	48.8	56.6	49.0	43.6	46.8	44.7	61.7	55.1
Tuscon, Arizona	6/29	5:30a	43.4	47.6	42.7	41.4	42.4	43.1	50.3	48.3
El Paso, Texas	6/30	9:15a	40.6	44.0	43.4	42.3	42.7	43.2	44.6	44.0
Dalhart, Texas	7/1	9:30a	39.8	42.4	42.1	41.0	41.5	42.9	41.1	41.0
Kansas City, Kan.	7/2	8:30a	39.7	41.7	42.2	40.4	40.4	42.2	38.8	38.7
Joliet, Illinois	7/3	noon	40.5	41.7	42.1	40.7	39.6	42.1	38.1	37.9
Meadville, Pa.	7/4	4:30p	40.1	40.7	41.4	39.8	39.0	40.9	37.4	37.2
Jersey City and New York	7/5	7:00p	39.6	40.1	40.3	39.1	38.9	40.1	36.7	36.4
ditto	7/6	7:00p				39.6	39.0			
ditto	7/7	7:00p						41.0		
ditto	7/8	9:00a			40.1					
ditto	7/9	7:00p			40.6					

TABLE 8

Inspection of Commercial pack
when unloaded at New York.

Calif. Melon 1942-1

Car.	Date Unloaded	Shipping data.	Color and condition
A	July 5	PFE.74919, Honeyball, 3 high, precooled to 54°.	Fancy: Firm, cream color, 3% slightly soft. Good.
B	5	PFE.74746, Honeyball, 4 high, precooled to 66°	Fancy: Firm to fairly firm, cream to light yellow, 4% slightly soft, slightly too ripe for best market.
C	9	PFE.74604, Honeyball, 4 high, precooled to 49°.	Fancy: Hard to firm, greenish white, still too green after 4 days on track. Hard-ripe: Fairly firm, cream color, 8% slightly soft 1% soft.
D	6	PFE.74765, Honeyball, 4 high, precooled to 45°.	Fancy: Hard, greenish white, too green for best market. Hard-ripe: Firm, cream color, 3% slightly soft. Good.
E	6	PFE.74499, Cantaloup, 3 high, precooled to 50°. (rule 247)	Fancy: Hard, not breaking with yellow color, too green. Hard-ripe: Firm, breaking to yellow, 7% slightly soft, slightly ripe for best market.
F	7	PFE.74712, Cantaloup, 3 high, precooled to 47°. (rule 254)	Fancy: Hard, not breaking with yellow, too green. Hard-ripe: Firm, breaking with yellow, 4% slightly soft, Good.
G	5	PFE.76295, Cantaloup, 4 high, precooled to 67°. (Preco fans)	Fancy: Firm, breaking to yellow, 5% slightly soft, Good.
H	5	PFE.76163, Cantaloup, 5 high precooled to 59°. (Preco fans)	Fancy: Fairly firm, yellow especially in middle layers, 7% slightly soft, Riper than car G.

Table 9

Condition of Hard Ripe Cantaloups in test crates upon arrival at New York
Unloaded or out of refrigerated space 11:00 p.m., July 6, 1942
Inspected 1:00 p.m., July 7, 1942

Crate	Car	1/	Load	Location	Condition		Marketability
					Pack	Fruit	
1	A	55°	3-high	Bottom layer; doorway	Tight	Firm slightly yellow	good
2	A	52°	"	Top layer; doorway	Slightly loose	"	"
3	E	53°	"	Bottom layer; doorway	Tight	"	"
4	E	47°	"	Top layer; doorway	Slightly loose.	Firm slightly yellow to yellow.	"
5	G	66°	4-high	Bottom layer; doorway	Tight	Firm slightly yellow	"
6	G	67°	4-high	Middle layer; doorway	"	"	"
7	H	58°	5-high	Bottom layer; doorway	"	"	"
8	H	62°	"	Middle layer; doorway	"	Firm slightly yellow to yellow	slightly ripe; but not soft.

1/ Melon temperature after precooling. Average of layer.

TABLE 10

SUMMARY OF DATA OBTAINED DURING PRECOOLING OF CANTALOUPS

1942

Car	Load	Cooling period	Average fruit temp.		Temp. drop		Salt used	Ice melted	Heat removed from load				Av. temp. of air blast	Equipment
			Start	Finish	Total	per hr.			3/ Sensible	4/ Vital	5/ Total	per 1,000 lbs. ice melted		
	crates	hours	°F	°F	°F	°F	lbs.	lbs.	B.t.u.	B.t.u.	B.t.u.	B.t.u.	°F	
A	288	6¾	71.9	54.1	17.8	2.64	125	5,088	362,105	42,567	404,672	79,534	43.4	Portable fans
B	384	8¼	87.1	65.6	21.5	2.46	250	7,592	583,166	129,279	712,445	93,842	47.4	"
C	384	8½	74.7	48.5	26.2	3.08	---	1/ 1,932	710,649	66,366	777,015	------	40.4	Gen. Am.
D	384	10	64.0	45.0	19.0	1.90	---	1/ 1,976	515,356	42,042	557,398	------	40.0	"
E	288	10	71.2	50.4	20.8	2.08	---	2/ -----	423.134	54,054	477,188	------	40.8	"
F	288	10	68.0	46.7	21.3	2.13	---	1/ 1,850	433,306	36,036	469,342	------	39.5	"
G	384	8	83.1	67.3	15.8	1.98	300	8,735	428,559	117,237	545,796	62,484	50.2	Preco
H	480	9¼	70.1	58.9	11.2	1.21	400	8,558	379,736	111.111	490,847	57,355	49.4	"

1/ Ice needed to refill the bunkers after precooling by mechanical refrigeration.

2/ Car not iced until after precooling was finished.

3/ Based on 75 lbs. fruit sp. heat .92 and 5 lbs. wood sp. heat .527 per crate.

4/ Interpolation based on 26,400 B.t.u./ton/day at 90°F., 24,200 B.t.u./ton/day at 74°F., 4,400 B.t.u./ton/day at 50°F 2,200 B.t.u./ton/day at 32°F., (Data from Tech. Bul. 730.)

5/ Heat penetrating car from outside and heat generated by precooling fan motors not included.

TABLE 11

Temperature of melon in center of crate compared with outer layer and car average during precooling. 1/

Time	Doorway stack				4th stack		Bunker stack		Car av. 9 points
	Bottom crate		Top crate		Top crate		Top crate		
	Outer melon	Center melon	Outer melon	Center melon	Outer melon	Center melon	Outer melon	Center melon	
	°F	°F	°F	°F	°F	°F	°F	°F	°F
				Car E, 3 layers high					
1:00 p	73.5	79.0	69.5	75.5	73.0	75.5	73.5	66.0	72.8
1:30 p	69.0	77.5	64.5	73.5	63.0	70.0	65.5	63.0	71.0
2:30 p	64.0	72.0	55.0	70.0	51.5	63.0	56.5	57.5	64.3
3:30 p	61.0	68.5	50.5	67.5	46.0	59.0	51.5	54.0	63.8
5:30 p	55.0	60.5	43.0	61.5	40.0	50.5	44.5	47.5	57.4
7:30 p	51.5	55.0	42.5	57.0	40.5	49.0	41.5	45.0	52.8
9:30 p	50.5	53.0	42.5	55.5	40.5	47.3	41.5	44.5	52.3
11 pm	48.0	50.0	38.5	52.5	40.0	46.0	40.5	43.0	50.4
				Car D, 4 layers high					
1:00 p	59.5	62.5	70.0	67.5	65.0	64.5	66.0	60.0	63.3
1:30 p	52.5	61.0	50.5	----	55.0	33.5	52.0	57.5	61.2
2:30 p	48.5	56.5	45.5	----	49.0	60.5	46.5	51.5	58.4
3:30 p	45.5	53.5	41.5	----	46.5	58.5	43.5	48.0	56.3
5:30 p	41.5	47.5	38.0	----	42.5	53.5	39.0	42.0	51.6
7:30 p	42.0	45.0	39.5	----	40.5	50.5	39.5	39.5	49.0
9:30 p	42.0	42.5	40.5	----	40.5	48.0	40.5	38.5	----
11 pm	41.5	41.0	38.5	44.0	39.0	45.5	38.0	36.5	45.0

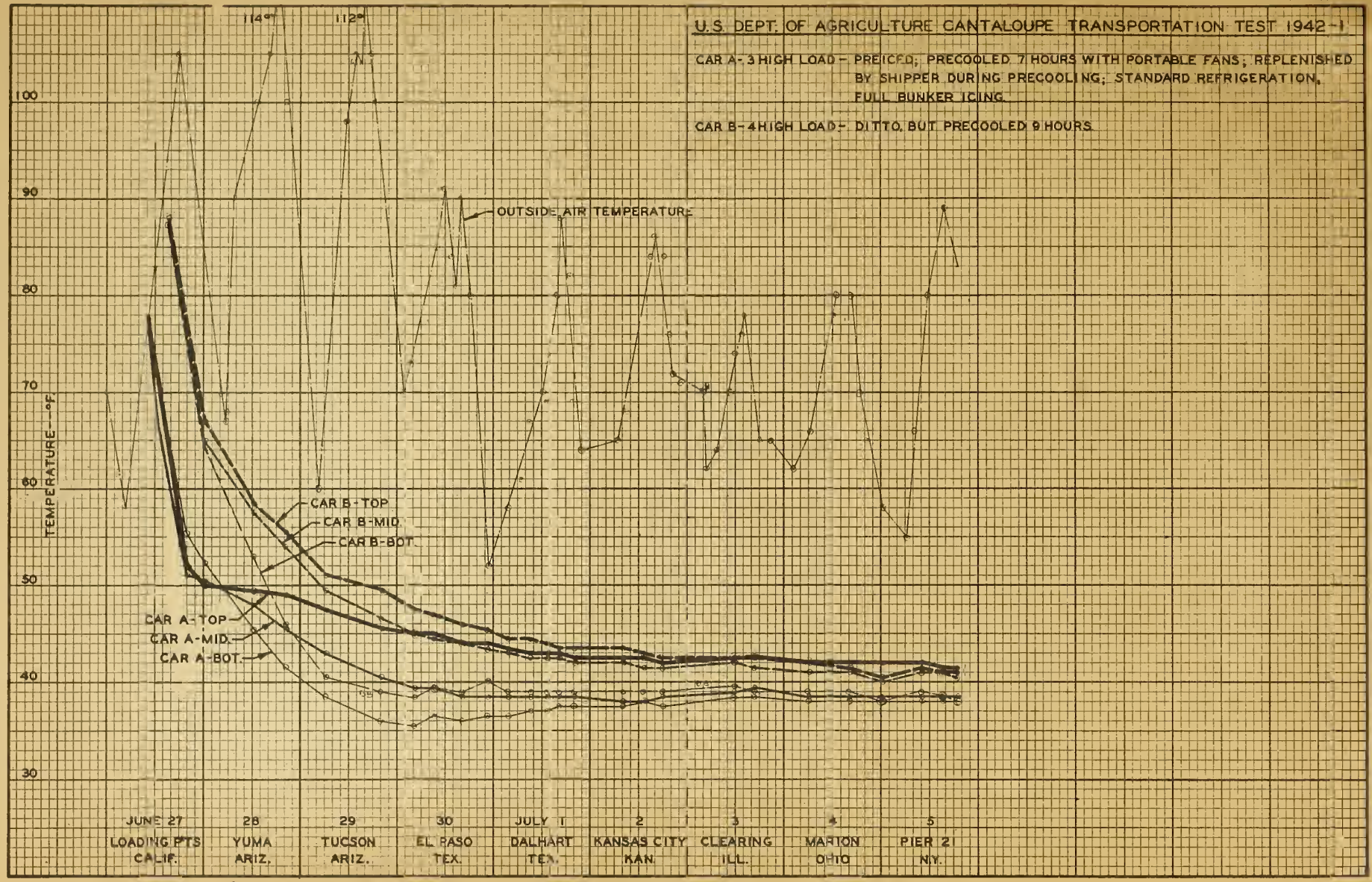
1/ Size 36 and 45 jumbo melons precooled with mechanical track side equipment with air blast at top doorway.

CANTALOUPE REFRIGERATION TEST - CALIFORNIA TO NEW YORK

EN ROUTE: JUNE 28, TO JULY 5, 1942. ROUTE: S.P.- C.R.I.&P.- B.R.C. OF C.- ERIE RYS.

AVERAGE MELON TEMPERATURES - TOP, MIDDLE, AND BOTTOM LAYERS

CHART 1



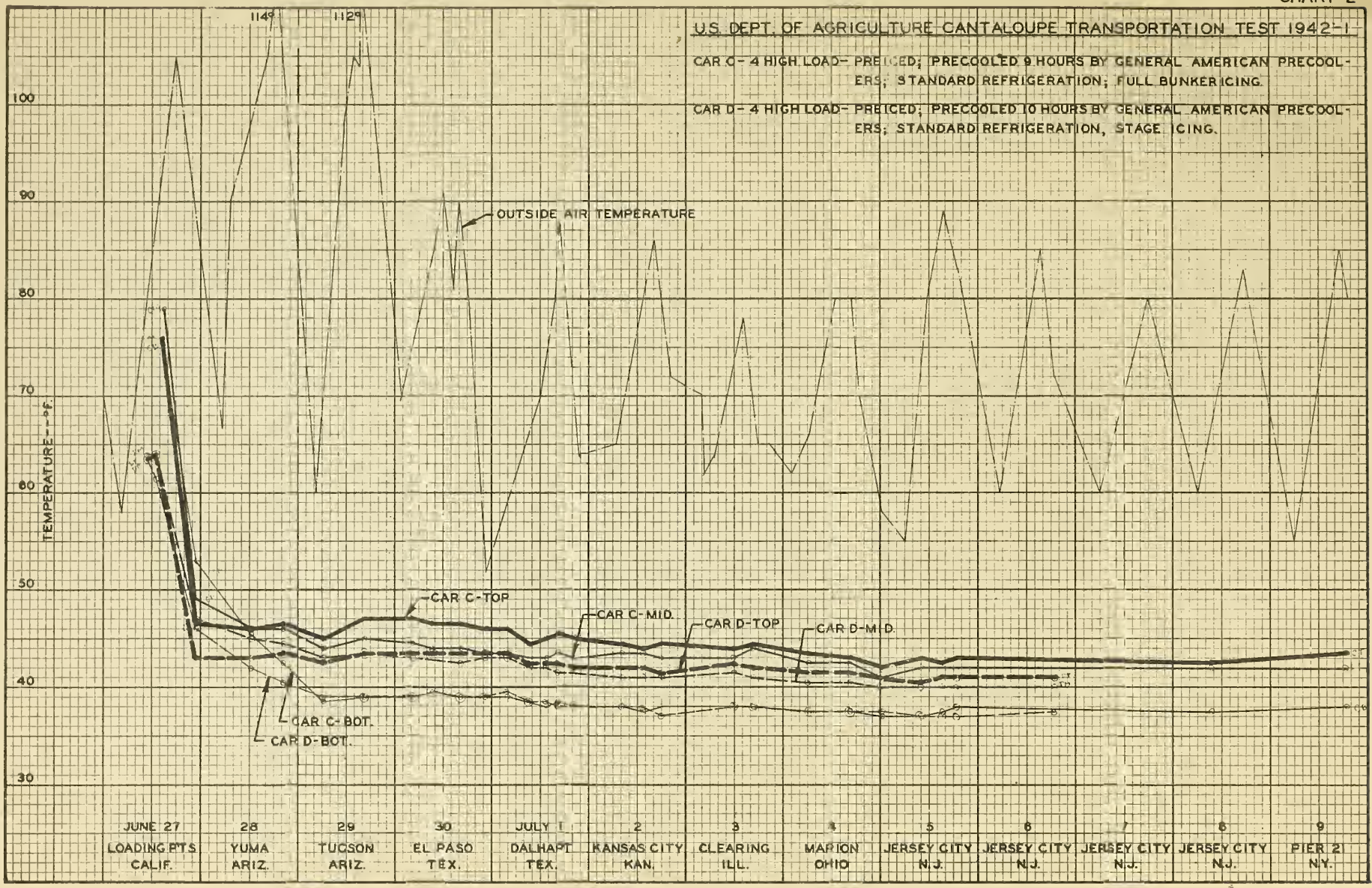
CAR A - P.F.E. 74919
" B - " 74748

CANTALOUPE REFRIGERATION TEST - CALIFORNIA TO NEW YORK

EN ROUTE JUNE 28, TO JULY 5, 1942. ROUTE: S.P. - C.R.I.&P. - B.R.C. OF C. - ERIE RYS.

AVERAGE MELON TEMPERATURES - TOP, MIDDLE, AND BOTTOM LAYERS

CHART 2



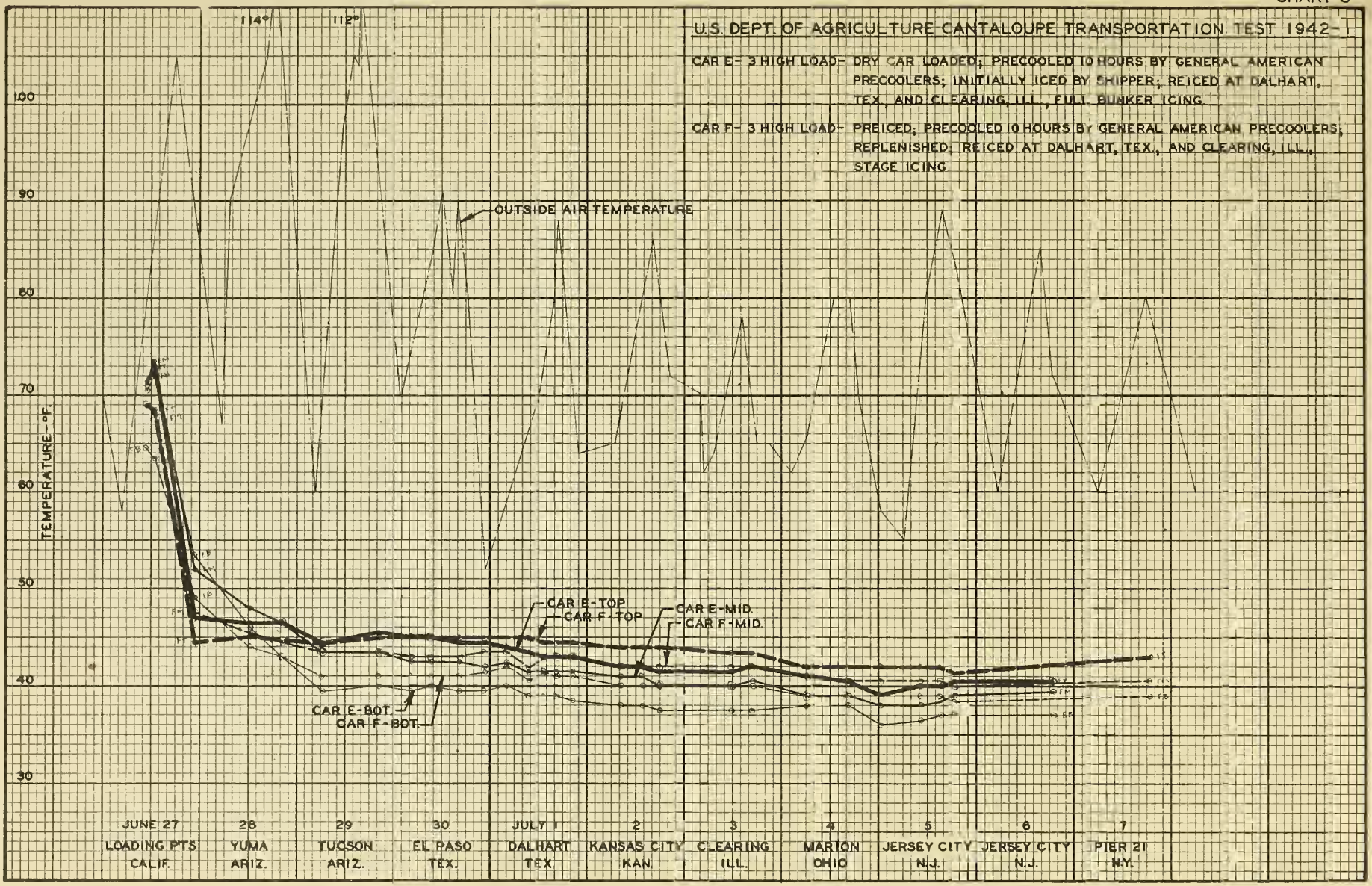
CAR C - P.F.E. 74804
" D - " " 74765

CANTALOUPE REFRIGERATION TEST - CALIFORNIA TO NEW YORK

EN ROUTE JUNE 28, TO JULY 5, 1942. ROUTE: S.P.- C.R.I.&P.- B.R.C. OF C.- ERIE RYS.

AVERAGE MELON TEMPERATURES - TOP, MIDDLE, AND BOTTOM LAYERS

CHART 3


U.S. DEPT. OF AGRICULTURE CANTALOUPE TRANSPORTATION TEST 1942-1
CAR E- 3 HIGH LOAD- DRY CAR LOADED; PRECOOLED 10 HOURS BY GENERAL AMERICAN PRECOOLERS; INITIALLY ICED BY SHIPPER; REICED AT DALHART, TEX., AND CLEARING, ILL., FULL BUNKER ICING.
CAR F- 3 HIGH LOAD- PREICED; PRECOOLED 10 HOURS BY GENERAL AMERICAN PRECOOLERS; REPLENISHED; REICED AT DALHART, TEX., AND CLEARING, ILL., STAGE ICING
114°
112°
OUTSIDE AIR TEMPERATURE
CAR E-TOP
CAR F-TOP
CAR E-MID.
CAR F-MID.
CAR E-BOT.
CAR F-BOT.
TEMPERATURE - °F.
100
90
80
70
60
50
40
30
JUNE 27 LOADING PTS CALIF.
28 YUMA ARIZ.
29 TUCSON ARIZ.
30 EL PASO TEX.
JULY 1 DALHART TEX
2 KANSAS CITY KAN.
3 CLEARING ILL.
4 MARION OHIO
5 JERSEY CITY N.J.
6 JERSEY CITY N.J.
7 PIER 21 N.Y.

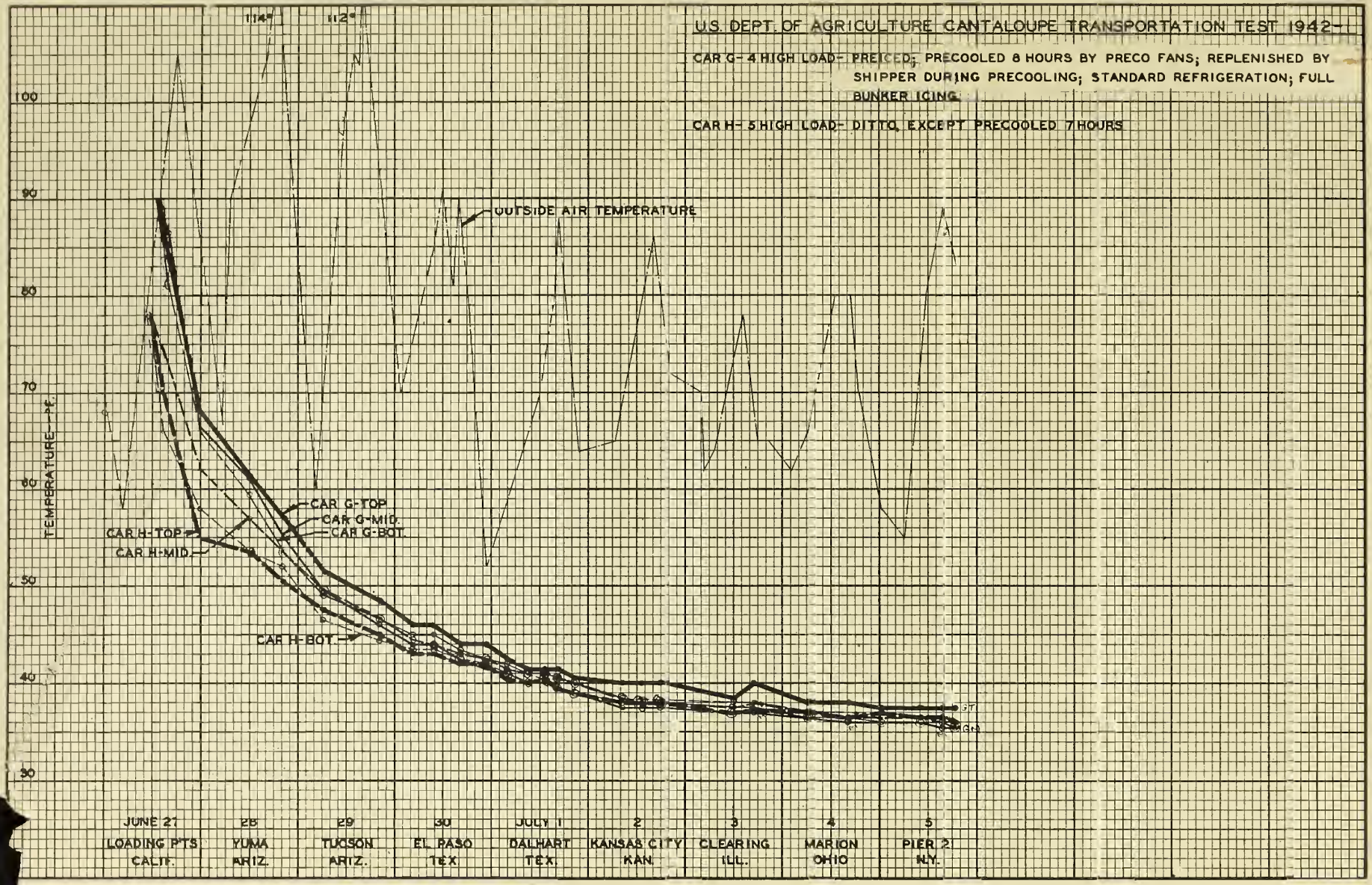
CAR E- P.F.E. 74499
" F- " 74712

CANTALOUPE REFRIGERATION TEST - CALIFORNIA TO NEW YORK

EN ROUTE JUNE 28, TO JULY 5, 1942. ROUTE: S.P.- C.R.I.& P.- B.R.C. OF C.- ERIE RYS.

AVERAGE MELON TEMPERATURES - TOP, MIDDLE, AND BOTTOM LAYERS

CHART 4



CAR G- P.F.E. 76295
" H- " 76163